PROC. ENTOMOL. SOC. WASH.
85(1), 1983, pp. 121–127

ETHOLOGY OF *LAPHYSTIA RUFOFASCIATA* CURRAN (DIPTERA: ASILIDAE) IN WYOMING[1]

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Abstract.—*Laphystia rufofasciata* Curran has a limited distribution in southern Wyoming. No courtship occurs in this species and males take a simple male over female mating position. This species captures prey in the air and manipulates it with the fore- and hindtarsi while resting on the substrate. The most commonly taken prey belong to the orders Diptera and Homoptera.

Laphystia rufofasciata Curran was described in 1931 from specimens collected in Green River and Rock Springs, Wyoming. Wilcox (1960) added Rangely, Colorado, to its distribution, and in 1978, the senior author collected a series of specimens in an intermittent stream bed 23.9 mi. S. of Wamsutter, Carbon County, Wyoming. So far as is presently known, the species is restricted distributionally to northwestern Colorado and southern Wyoming.

A population of these asilids was located at Thayer Junction, a railroad siding 27 km northeast of Rock Springs in Sweetwater County. Since nothing was known of the behavior of members of this genus, a study was initiated in 1976 (19–26 July), and continued in 1977 (20–21 July) and 1979 (24 July–2 Aug). Adults of *L. rufofasciata* were found within and along the banks of intermittent stream beds (Fig. 1). The dominant vegetation on the banks of the streams was *Sarcobatus vermiculatus* (Hook.) Torr. (black greasewood) and *Chrysothamnus linifolius* Greene (rabbitbrush).

Diurnal short distance migrations are characteristic of this species. Prior to ca. 1000 h, asilids are found resting on sand among plants on the stream bank. Thereafter, as temperatures rise above 38°C, the flies drift downwards to the damp sand along the narrow watercourse, which may or may not contain water, as well as onto various "islands." The bulk of the day is spent in this moderated environment, and, ca. 1700 h, there is a reverse migration to the nocturnal resting place.

Voucher specimens on which this paper is based have been placed in the entomological collection of the Smithsonian Institution, Washington, D.C., as Lot #46.

[1] Published with the approval of the Director, Wyoming Agricultural Experiment Station, as Journal Article No. JA. 1175.

Foraging and Feeding Behavior

Laphystia rufofasciata foraged under sunny skies when soil surface temperatures exceeded 24°C. On cloudy or windy days little or no foraging took place. Unlike many other asilid species which sometimes utilize vegetation, *L. rufofasciata* always initiated flights from sunlit or shaded sand.

Prior to attack initation either the asilid's head only or the entire body is turned towards the organism. Additionally, if large fast-moving insects fly nearby, the same behavior is exhibited by the robber flies.

Approximately half the attacks (52%) are initiated towards potential prey 15–20 cm distant. Most of the remaining observed forage flights (44%) covered distances ranging from 20 to 60 cm. Only 4% exceeded 60 cm. Successful forage flights resulting in prey capture covered distances of 9 to 30 cm with 72% being less than 20 cm. Prey is ordinarily picked out of the air, but on one occasion a female collected a crawling mite and on another a male made two unsuccessful strikes at a small crawling microlepidopteran.

Foraging efficiency appears to be good. The predator averages six forage flights before taking prey, with 30% of the first observed attempts being successful. Unsuccessful attempts to secure prey were caused by the following: 1) The prey either outdistanced the pursuer or exhibited evasive flight; 2) asilids flew towards potential prey but then turned back before making contact; and 3) the insect was contacted, held briefly and then released. The asilids had particular trouble subduing tiny wasps. A female collected a wasp, circled several times, landed, flipped on her back, manipulated the prey with all six tarsi for a short time, and then released it. Within a minute's time she repeated the exercise with the same result.

When contact with prey was made, the asilid would swing back and forth in the air, much in the manner of a courting male *Stichopogon trifasciatus* (Say) (Lavigne and Holland, 1969), but manipulating the prey. The prey was always impaled on the asilid's proboscis when returning from a successful forage flight. Usually the proboscis is initially inserted dorsally or dorsolaterally into the prey's thorax.

Subsequent prey manipulation depended upon the size of prey taken. Prey measuring 2.0 mm or over may be manipulated several times while feeding takes place. Smaller prey are not manipulated. The asilid uses it's fore- and hindtarsi to manipulate the prey. The tip of the abdomen is brought to rest upon the substrate, and in combination with the midtarsi acts as a tripod to steady the asilid during prey manipulation. When feeding is completed, the prey is wiped from the proboscis using the foretarsi, either on site (67%) or in flight (33%) (N = 39). *Laphystia rufofasciata* may take flight after prey, with a prey still impaled on its proboscis. If so, the original prey is pushed off before contact is made with the new prey.

Feeding activity has been recorded as early as 0840 h and as late as 1707 h (soil surface temperatures 24° and 34°C, respectively). While feeding activity by females is more or less continuous from 0900 to 1700 h, peaks of feeding were observed between 1200–1300 and 1400–1600 h. Males, on the other hand, apparently spend much of their time searching for females. Of the 130 prey collected where the sex of the predator was ascertained, only 25 (19%) had been taken by males.

Like most asilid species, the length of time *Laphystia rufofasciata* spends feeding

Fig. 1. Intermittent stream habitat of *Laphystia rufofasciata* at Thayer Junction, Sweetwater Co., Wyoming.

on a prey is somewhat variable, but a positive correlation with prey size exists ($r = 0.7$). Large prey such as mosquitoes and dolichopodids (4 mm) were fed upon longer than were aphids and cecidomyiids (2 mm). The average feeding time per prey was 7.77 min ($N = 22$), ranging from 1.5 to 31 min.

During feeding the asilid's abdomen is sometimes rapidly moved up and down, but the function of this behavior is unclear.

Prey Selection

Based on the definition used by Lavigne and Holland (1969), we classify *L. rufofasciata* as euryphagic. Of the 137 recorded prey, 59.1% are Diptera, 16.8% are Homoptera, 9.5% are Hemiptera, 7.3% are Hymenoptera, 3.7% are Araneae, 1.5% are Coleoptera, 1.5% are Psocoptera, and 0.6% are Lepidoptera.

Although the predators are fairly uniform in size, with the male ($\bar{x}$ 8.4 mm, $N = 28$) being smaller than the female ($\bar{x}$ 9.4 mm, $N = 7$), the prey size ranged widely. Prey taken by males ranged from 0.8 mm–4.8 mm with the mean size being 1.65 mm ($N = 26$). Prey taken by females ranged from 0.5 mm–6.3 mm with the mean size being 2.19 mm ($N = 97$). The predator to prey ratio is one of the largest for species of Asilidae thus far studied in Wyoming, being 5.09:1 for males and 4.29:1 for females (Table 1). Only *Heteropogon wilcoxi* James has a larger ratio (8.42:1) (Lavigne and Holland, 1969). The size of prey was assumed to be the determining factor of prey selection in this species.

At the site 23.9 mi south of Wamsutter mentioned earlier, adults of both sexes of *L. rufofasciata* were slightly smaller than those at Thayer Junction although

Table 1. Relation between length of *Laphystia rufofasciata* and its prey.

Sex	Predator Length (mm)[1]			Prey length (mm)			No. of Prey Measured	Mean Ratio of Predator to Prey
	Minimum	Maximum	Mean	Minimum	Maximum	Mean		
Male	7.6	8.8	8.4	0.8	4.8	1.6	26	5.1
Female	8.9	9.9	9.4	0.5	6.3	2.2	97	4.3

[1] Predator size: ♂♂ ($N = 28$) $\bar{x} = 8.44 \pm 0.33$, ♀♀ ($N = 7$) $\bar{x} = 9.4 \pm 0.34$.

the male to female size proportions were comparable (♂ $\bar{x}$ 8.2, $N = 10$; ♀ $\bar{x}$ 9.1, $N = 9$). Presumably members of this population took slightly smaller prey.

Separation of prey records on the basis of sex shows that Diptera are the overwhelming choice for both sexes (Table 2), with the second choice being Hymenoptera for males and Homoptera for females.

Since prey were collected from *Laphystia* in two different years, it was of interest to see if there was any difference in prey selection between years. As can be seen in Table 3, Diptera and Homoptera were the most often taken prey in both 1976 and 1979 with Diptera being the most preferred. These data are similar to those presented by Adamovic (1963) for *Dysmachus bilobus* Loew in Yugoslavia.

Herein is presented the list of prey taken by *L. rufofasciata*. Specific identifications are presented where possible, but the state of taxonomic knowledge and/or the condition of the specimen sometimes precluded its identification to definitive levels. The number of observations and sex, when known, of the predator are indicated in parentheses following the prey taxa.

ARACHNIDA, Araneae: undet. vii-21-76 (3 ♀, ?), vii-26-76 (?). COLEOPTERA, Staphylinidae: vii-21-76 (♀), vii-23-76 (?). DIPTERA, Agromyzidae: *Cerodontha dorsalis* (Loew), vii-23-76 (♀); Anthomyiidae: *Hylemya platura* (Meigen), vii-27-79 (♀); Bombyliidae: *Geron* sp., vii-25-79 (♀), *Phthiria* sp., vii-27-79 (♀), undet., vii-20-76 (♂), vii-25-76 (♂); Cecidomyiidae: *Anarete* sp., vii-25-76 (♂), vii-24-76 (♀), *Micromya johannseni* (Felt), vii-25-79 (♀), *Neolasioptera* sp., vii-27-79 (3 ♀), vii-1-79 (♂); Ceratopogonidae: *Dasyhelea mutabilis* (Coquillett), vii-24-76 (♀), vii-25-76 (♂), vii-26-76 (♀), *Leptoconops sublettei* Clastrier, vii-21-76 (♀), vii-26-76 (♂); Chamaemyiidae: undet., vii-21-76 (♀); Chironomidae: *Cricotopus* sp.,

Table 2. Total numbers and percentages of prey of different taxa captured by males and females of *Laphystia rufofasciata*. Does not include 7 prey for which the sex of the predator is unknown.

Taxa	Male		Female		Range (mm)	$\bar{x}$
	No.	%	No.	%		
Araneae	—		3	2.9	0.5–2.5	1.14
Coleoptera	—		1	0.95	2.4	—
Diptera	17	68	61	58.1	0.7–3.9	2.04
Hemiptera	1	4	12	11.4	1.7–3.4	2.32
Homoptera	2	8	20	19.0	0.8–4.0	2.28
Hymenoptera	3	12	7	6.7	0.6–6.3	1.88
Lepidoptera	1	4	—		4.8	—
Psocoptera	1	4	1	0.95	0.8–1.8	1.33
Totals	25	100	105	100	0.5–6.3	2.13

Table 3. Comparison of numbers and percentages of prey of different taxa captured by *Laphystia rufofasciata* in 1976 versus 1979.

Taxa	1976		1979		Total	
	No.	%	No.	%	No.	%
Araneae	5	5.3	—		5	3.6
Coleoptera	2	2.0	—		2	1.5
Diptera	53	54.6	28	70.0	81	59.1
Hemiptera	13	13.4	—		13	9.5
Homoptera	13	13.4	10	25.0	23	16.8
Hymenoptera	9	9.3	1	2.5	10	7.3
Lepidoptera	—	—	1	2.5	1	0.7
Psocoptera	2	2.0	—		2	1.5
Totals	97	100	40	100	137	100

vii-26-79 (♀); Chloropidae: *Conioscinella flavescens* (Tuck.), vii-21-76 (♀), vii-23-76 (2 ♀), vii-24-76 (3 ♀), vii-25-76 (♀), *Meromyza communis* Fed., vii-21-76 (♀), *Olcella* sp., vii-26-76 (♀), *Oscinella frit* (L.), vii-26-76 (?), *Siphonella neglecta* Beck., vii-26-76 (♂, ♀), vii-1-79 (♀), *Thaumatomyia pulla* (Adams), vii-26-79 (♀), vii-27-79 (♀), undet., vii-24-76 (♀); Culicidae: undet. vii-20-76 (?); Dolichopodidae: *Asyndetus* sp., vii-21-76 (♀), vii-24-76 (♀), *Thinophilus* sp., vii-23-76 (2 ♀); Drosophilidae: undet., vii-22-76 (♀); Ephydridae: *Atissa pygmaea* (Haliday), vii-21-76 (♀), vii-24-76 (2 ♂, ♀), vii-25-76 (2 ♂, ♀), vii-26-76 (♂), vii-27-79 (2 ♀); Lonchopteridae: undet., vii-20-76 (♀); Muscidae: undet., vii-21-76 (♀); Pipunculidae: *Pipunculus* sp., vii-31-79 (♀); Scatopsidae: *Scatopse fuscipes* (Meigen), vii-21-76 (♀); Sciaridae: *Bradysia* sp., vii-21-76 (♀), vii-26-76 (♀); Sepsidae: *Sepsis* sp., vii-26-76 (♀); Sphaeroceridae: *Leptocera* sp., vii-24-76 (♀), vii-25-76 (2 ♀); Tachinidae: *Hyalomya aldrichii* Townsend, vii-25-76 (2 ♀, ?), vii-26-79 (4 ♀), viii-1-79 (♂); Tethinidae: *Pelomyia coronata* (Loew), vii-26-79 (♀), undet., vii-25-79 (♀). HEMIPTERA. Anthocoridae: *Orius* sp., vii-26-76 (♀); Miridae: undet., vii-20-76 (4 ♀), vii-21-76 (2 ♀), vii-24-76 (2 ♀), vii-25-76 (♂), vii-26-76 (♀); Saldidae: *Saldula* sp., vii-26-76 (♀). HOMOPTERA, Aphididae: *Aphis* sp., vii-20-76 (♀), undet., vii-25-79 (?); Cicadellidae: *Aceratagallia poudris* Oman, vii-20-76 (♂, 3 ♀), vii-21-76 (3 ♀), *Aceratagallia sanguinolenta* (Provancher), vii-25-79 (5 ♀), vii-26-79 (♀), *Empoasca* sp., vii-27-79 (♀); Cixiidae: *Oliarus* sp., vii-26-76 (♀); Margarodidae: *Craspedolepta nebulosa* (Zetterstedt), vii-21-76 (♂, 2 ♀), *Craspedolepta suaedae* (Crawford), vii-20-76 (♀), ?*Margarodes* sp., vii-25-79 (♀). HYMENOPTERA, Encyrtidae: undet., vii-26-76 (♀); Eulophidae: *Chrysocharis* sp., vii-24-76 (♀), *Chrysonotomyia* sp., vii-21-76 (♀), undet., vii-24-76 (♀); Formicidae: *Formica* sp. (winged reproductive), vii-20-76 (♀); Mymaridae: *Gonatocerus* sp., vii-25-76 (♂). LEPIDOPTERA, undet., vii-31-79 (♂). PSOCOPTERA, Lachesillidae: *Lachesilla* sp., vii-20-76 (♀); Psocidae: *Camelopsocus similis* Mockford, vii-26-76 (♂).

Mating Behavior

Males are much more active than females which is apparently related to mating behavior. Males come and go rapidly, rarely staying in one spot for more than a few seconds. Searching flights of up to 6 m are made by males in their quest for females. These meandering flights, between plants at about 30–90 cm above the

Fig. 2. Copulating pair of *Laphystia rufofasciata* illustrating the male over female mating position.

substrate, are not exhibited by females. Males chase after almost any insect that circles, following about 30 cm behind. Female *Laphystia,* when chased, exhibit evasive flight, which is obviously an attempt to avoid predation. When a *Laphystia* female lands, the male also lands and then makes a short hop flight, thus confronting the female in a new position in front or to either side. If the female flies off and is lost by the male, he will return repeatedly to the spot where the female was last encountered.

Males flying above an object on the soil surface, often circle it, hovering briefly and then fly off. Should the object be a male *Laphystia,* it will fly up and the two males will circle briefly before flying off in opposite directions, a common occurrence. If the insect is a *Laphystia* and doesn't fly, the male will land on its back and immediately attempt copulation.

Of the 36 recorded male-female copulation attempts, 73% occurred between 1200 and 1600 h. Soil surface temperatures recorded at these times ranged from 33 to 50°C ($\bar{x}$ 37.9). On two occasions, a male was observed to mount and unsuccessfully copulate with the same female three different times in succession. On two other occasions, prior to the attempt at copulation, males hovered briefly in front of females, with the male's body swinging from side to side subtending an arc of 35 degrees. Each time the female flew off with the male in pursuit.

In three years only two pairs were observed, one a complete mating and one incomplete. The complete mating was initiated at 1125 h (VII-25-79) when a male jumped on the dorsum of the female taking the male atop female position (Fig 2). Copulation ensued and the pair separated at 1130 h, with both specimens flying off in different directions. On another occasion at 1233 h (VII-20-77), a

mated pair (male atop female) was observed resting on a sandbar. They were disturbed twice by the senior author and then separated. The female flew, followed by the male, and when the female landed copulation reoccurred. The pair remained joined until 1245 h when the male initiated separation by releasing his claspers and flying away. The female remained in place 15–20 sec. and then flew. The substrate temperature under partly cloudy skies was 34.5°C. Soil surface temperatures at which attempted copulations were observed varied from 33°–50°C ($\bar{x}$ 36.6, $N = 13$).

Acknowledgments

We express our appreciation to the following taxonomists for identification of the various prey: R. H. Foote (Agromyzidae), R. J. Gagné (Cecidomyiidae, Muscidae, Scatopsidae, Sciaridae), E. E. Grissell (Eulophidae), L. Knutson (Bombyliidae), J. P. Kramer (Cicadellidae, Cixiidae), D. R. Miller (Margarodidae), C. W. Sabrosky (Chloropidae, Tachinidae), D. R. Smith (Formicidae), M. B. Stoetzel (Aphididae), F. C. Thompson (Anthomyiidae, Dolichopodidae, Pipunculidae) and W. W. Wirth (Ceratopogonidae, Chironomidae, Ephydridae, Sphaeroceridae, Tethinidae) of the Systematic Entomology Laboratory, USDA; W. N. Mathis (Ephydridae) of the National Museum of Natural History, Smithsonian Institution; and E. L. Mockford (Psocoptera) of Illinois State University, Normal, Illinois.

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